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Research Article

## In Vivo study of Antidiabetic Activity from Ethanol Extract of *Clitoria ternatea* L. Flower

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### Abstract

**Background:** *Clitoria ternatea* L. or telang flower is a plant whose all parts have benefits for the human body. The benefits of telang flower include antioxidant, antidiabetic, antiobesity, anticancer, anti-inflammatory, antibiotic and hepatoprotective agent. *Clitoria ternatea* L. flower as an antidiabetic treatment works by increasing insulin secretion, inhibiting the formation of advanced glucose end products, as well as inhibiting the work of enzymes involved in the production of glucose in the blood. In this study using an experimental method, using 25 mice which were divided into 5 groups. The negative control group (aquadest), the positive control group (glibenclamide 5 mg), and the three groups with variations in the dose of 96% ethanol extract of telang flower 200, 400, 600 mg/kg BW. **The results:** The results showed that the negative control group did not experience a decrease in blood sugar levels; the positive control group by giving glibenclamide 5 mg experienced a decrease in blood sugar levels of up to 48.6 mg/dl. In 200 mg dose extract; 400; 600 mg of tested animals showed a decrease in blood sugar up to 48.2 mg/dl, 31.2 mg/dl, 43 mg/dl respectively. **The conclusion:** Based on the data obtained, it was then analyzed statistically using the One Way ANOVA test, resulting in a significant value <0.05, then the Kruskal-Wallis Test was carried out. It could be concluded that there was a significant difference in decreasing blood sugar levels. Different dose of *Clitoria ternatea* L. extract gives a significant effect on reducing blood sugar levels.

**Keywords:** Antidiabetic, Extract, *Clitoria ternatea* L., Flower

## INTRODUCTION

*Clitoria ternatea* L. flower is increasingly popular in Indonesia which provides many health benefits. *Clitoria ternatea* L. flower is one of the plants whose all parts have functional benefits for the human body. Part of the flower petals is useful as an antioxidant, antidiabetic, antiobesity, anticancer, anti-inflammatory, antibiotic and protects liver tissue. Several components of bioactive compounds found in telang flower are flavonol glycosides, anthocyanins, flavones, flavonols, phenolic acids, terpenoids and alkaloids, as well as cyclic peptide compounds or cyclotides<sup>1</sup>.

Diabetes is a degenerative disease and its incidence tends to increase in Indonesia. Current drug options for the treatment of diabetes, such as oral hypoglycemic drugs and insulin, have some limitations. Such as the sulfonylurea group can cause gastrointestinal disturbances in the form of nausea, diarrhea, abdominal pain, and hypersecretion of gastric acid. This has prompted many herbal medicines to be recommended for the treatment of diabetes<sup>7</sup>.

Several studies have proven the benefits of *Clitoria ternatea* L. flower as an antioxidant. Antioxidants in the body are needed in counteracting and overcoming oxidative stress

that has the potential to cause various degenerative diseases. Besides that, it is useful as an antidiabetic, with the mechanism of action of increasing insulin secretion, inhibiting the formation of advanced glucose end products, as well as inhibiting the work of enzymes involved in the production of glucose in the blood. Another benefit of *Clitoria ternatea* L. flower is related to its cholesterol-related activity, which is the inhibition of adipogenesis and hyperlipidemia<sup>2</sup>.

*Clitoria ternatea* L. flower and leaf extract can be a herbal treatment solution for diabetics. This leaf extract can lower blood sugar levels and increase insulin levels in the human body. The results showed that the leaf and flower extract of telang had a hypoglycemic effect in alloxan-induced diabetic rats. The extract is highly selective in managing complications associated with diabetes mellitus, hypercholesterolemia, hypertriglyceridemia and impaired renal function. Therefore, the extract of the leaves and flowers of telang shows that this plant can be used for therapy against complications of diabetes<sup>3</sup>. The antioxidant activity of the *Clitoria ternatea* L. flower extract showed a much higher activity compared to paper flowers and rosella flowers<sup>4</sup>.

From research by Rajamanickam et al. (2015), the water extract (400 mg/kg body weight) of *Clitoria ternatea* L. flower can significantly reduce blood sugar levels due to the inhibition of  $\alpha$ -galactosidase and  $\alpha$ -glucosidase activities<sup>1</sup>. From this background, it is important to conduct research on the antidiabetic activity of the ethanol extract of *Clitoria ternatea* L. flower against white male rats (*Rattus norvegicus*)<sup>2</sup>, with 3 variations of the dose used, namely 200 mg/kg Body weight, 400 mg/kg Body weight, 600 mg/kg Body weight.

## MATERIALS AND METHODS

The samples in this study were *Clitoria ternatea* L. flower in full bloom, fresh and purple in color obtained from the city of Medan. *Clitoria ternatea* L. flower has the characteristics of compound flowers, is formed in the axils of the leaves, has a cylindrical stalk, approximately 1.5 cm long, has funnel-shaped petals, a butterfly-shaped crown and is blue.

Oral probe, measuring cup, stirring rod, funnel, injection syringe (1 mL), gloves, markers, blender, glucometer (One-touch Select Simple), beaker glass, Erlenmeyer, animal scale, alloxan, 0.9% NaCl, aquadest, standard feed 551, ethanol 96%, glibenclamide 5 mg.

### Procedure

#### Preparation of *Clitoria ternatea* L. Flower Extract

*Clitoria ternatea* L. flower samples were cleaned of impurities and washed thoroughly and then cut into small pieces, dried in a drying cabinet at a temperature of 30-40°C, mashed using a blender until the powder. A total of 523 grams *Clitoria ternatea* L. flower powder was macerated with a ratio of 1 part of simplicia soaked in 10 parts of solvent. By using ethanol solvent 3750 mL 96% ethanol, in a tightly closed container for 5 days and protected from light, while stirring frequently. Then it was filtered to obtain maserate I, then the pulp was macerated again with 96% ethanol using the same procedure with 1250 ml of solvent in a tightly closed container for 2 days to obtain maserate II. The results obtained were collected and concentrated using a rotary evaporator at a temperature of 40°C with a speed of 120 rpm, then evaporated with a water bath until a thick extract was obtained<sup>13,24</sup>.

### Phytochemical Screening

#### Alkaloid Test

2 grams of *Clitoria ternatea* L. flowers added 25 mL of 25% v/v ammonia and added 20 mL of chloroform, then crushed. The mixture was filtered and then extracted with 10% v/v hydrochloric acid and the extract obtained was taken 5 mL and then added a few drops of Dragendorff's reagent and Mayer's reagent. The reaction is positive if the addition of the Mayer reaction and the Dragendorff reaction will form a white precipitate or a brick red precipitate<sup>14</sup>.

#### Flavonoid Test

Add a few drops of 37% HCl and add Mg powder. The test results showed that the ethanol extract of the *Clitoria ternatea* L. flower was positive for flavonoids which could be indicated by the red color produced after the HCl reagent and Mg were added<sup>14</sup>.

#### Steroid Test

1 g of the extract was added to 10 mL of ether, transferred to a vaporizer cup and a few drops of Lieberman Burchard's reagent were added. If there is a red or green color, it indicates the presence of steroid or triterpenoid compounds<sup>14</sup>.

### Glycoside Test

The sample solution was evaporated over a water bath, then concentrated anhydrous acetic acid and 10 drops of concentrated sulfuric acid were added, a color change to blue or greenish<sup>14</sup>.

### Anthocyanin Test

Add 2 ml of 2N HCl and add NH<sub>3</sub> to 2 ml of thick extract of *Clitoria ternatea* L. flower. The test results showed that the ethanolic extract of telang flower was positive for anthocyanin which was indicated by the formation of a red color after the addition of HCl which changed to purplish blue after being added with NH<sub>3</sub><sup>14</sup>.

### Tannin Test

5 mL of the extract solution of the pea flower was added a few drops of 1% FeCl<sub>3</sub>. If a blue-black color is formed, it indicates the presence of tannins. Then 5 mL of gelatin solution was added, if a white precipitate formed indicates the presence of tannin<sup>14</sup>.

### Characteristics of Simplicia

#### Determination of Water Soluble

1 g Simplicia put into an Erlenmeyer, add 25 mL of chloroform saturated water. Shake many times and the filtrate is filtered and evaporated to dryness in a shallow flat-bottomed dish that has been tarred. The residue was heated at a temperature of 105°C until a constant weight was obtained, calculate the concentration in % water-soluble extract<sup>15</sup>.

#### Determination of Total Ash

Simplicia and extract as much as 2 g each were weighed and put into a porcelain crucible which had a constant weight and then burned in a kiln at a temperature of 600 ± 25°C until destroyed, cooled and weighed. The total ash content is calculated against the weight of the test material, expressed in % w/w<sup>15</sup>.

#### Determination of Water

The water content was determined by toluene distillation. 5 g of Simplicia was put into a round bottom flask and the saturated toluene was added. Then heated for 15 minutes, until the toluene boils. After all the water is distilled, heating is continued for 5 minutes. Allow the receiving tube to cool to room temperature. The volume of water is read after the toluene and water are completely separated<sup>15</sup>.

#### Determination of Ethanol Soluble Extract Content

Weigh 5 g of simplicia, put it in a flask, add 100 mL of 96% ethanol. Shake many times for the first 6 hours, leave for 18 hours. The filtrate was filtered and evaporated to dryness in a porcelain dish with known constant weight. The residue is heated at a temperature of 105°C to a constant weight, calculate the concentration in % water soluble essence<sup>15</sup>.

### Test on Animal

This research was conducted in a Medan animal laboratory facility using 25 mice. Animals were conditioned for 7 days, with 12 hours of light and 12 hours of darkness at room temperature of 25-27°C. Blood collection through the tail vein (coccygeal vein). The blood was then measured using a glucometer<sup>12</sup>.

### Alloxan Induction

Fasting blood sugar levels were measured in rats with a glucometer, then 120 mg/kg Body weight alloxan was induced. Alloxan monohydrate dissolved in 0.9% NaCl was

injected intraperitoneally before the color changed from clear to pink. After being induced, the rats were fed adequate food within the first 24 hours and their drinking water was added with 40% D-glucose monohydrate solution to prevent hypoglycemia. The procedure for administering drugs intraperitoneally is by holding the nape of the neck so that the abdominal position is higher than the head position, injection of alloxan solution in the lower abdomen of rats to the left of the midsagittal line<sup>12</sup>.

### Glibenclamide Suspension

Based on the therapeutic dose of glibenclamide for humans weighing 70 kg is 5 mg. The conversion factor of a human weighing 70 kg to a rat weighing 200 g is 0.018, so the dose for a 200g rat is 0.09 mg. From the conversion results, in 0.6 mg of glibenclamide powder contains 5 mg of glibenclamide, for rats weighing 200 grams, the amount of glibenclamide powder given is:  $0.6 \text{ mg/kg Body weight} \times 200 \text{ grams} = 0.12 \text{ mg}$  dissolved in 5 ml of 0.5% CMC Na<sup>12</sup>.

### *Clitoria ternatea* L. Flower Ethanol Extract Suspension

The ethanol extract of *Clitoria ternatea* L. flower was suspended in 0.5% CMC Na until the required dose, for example, a dose of 200 mg/kg Body weight for rats weighing 200 grams, the ethanol extract of the *Clitoria ternatea* L. flower was weighed 40 mg. Then suspended in 2.5 ml of 0.5% CMC Na<sup>12</sup>.

### Antidiabetic Activity

Test In this study, 25 experimental animal rats were randomly divided into 5 groups, namely the control group (+), control group (-) and 3 treatment groups. Each test group consisted of 5 rats. After acclimation for 7 days, alloxan induced rats, then each group of rats were weighed and their blood glucose levels were measured as initial/normal blood glucose levels (91-140 mg/dl). Rats were fasted for 12-14 hours (no food, only water). Then each white rat was measured fasting blood glucose level. Furthermore, alloxan was induced at a dose of 120 mg/kg BW was injected intraperitoneally.

After 24 hours of alloxan induction, blood glucose levels were measured with a glucometer,

if hyperglycemic (200-400 mg/dl) occurred, the rat was declared to have diabetic<sup>17</sup>.

Then each group received the following treatment:

Group 1: As a negative control rat without alloxan induction were only given standard feed and aquadest every day for 7 days of treatment.

Group 2: As a positive control rat were given glibenclamide 5 mg oral every day for 7 days of treatment.

Group 3: *Clitoria ternatea* L. flower ethanol extract was given 200 mg/kg body weight orally every day for 7 days of treatment.

Group 4: *Clitoria ternatea* L. flower ethanol extract was given 400 mg/kg body weight orally every day for 7 days of treatment.

Group 5: *Clitoria ternatea* L. flower ethanol extract was given 600 mg/kg body weight orally every day for 7 days of treatment.

Oral administration was carried out with an oral probe that had been filled with suspension inserted into the mice mouth through the palate into the esophagus, pushing the solution into the esophagus<sup>12</sup>.

Note: Checking blood sugar levels in rats was carried out after alloxan induction on days 2,4,6, during treatment and on days 8 and 10 after treatment<sup>12</sup>.

## RESULT

### Result Simplicia and Extract

Simplicia obtained from drying of fresh flowers as much as 50% and used in the form of simplicia that has been mashed. Furthermore simplicia stored in a dry place, not damp and protected from light. To protect the simplicia so that it is not damaged or the quality is maintained. The yield of the extract obtained was 16.05%. The yield was the ratio between the extract obtained and the initial simplicia

### Result Phytochemical Screening of *Clitoria ternatea* L. flower

From of phytochemical screening, it was found that *Clitoria ternatea* L. flower contain flavonoids, steroids, terpenoids, saponins, tannins and glycoside.

**Table 1:** Phytochemical Screening Results of *Clitoria ternatea* L. Flower Ethanol Extract

No	Phytochemical Constituent	Test	Result	Keterangan
1.	Alkaloid	- Bouchardat - Mayer	- sediment - sediment	- -
2.	Flavonoid	- FeCl <sub>3</sub> - Mg.HCl - H <sub>2</sub> SO <sub>4</sub>	- green solution - red solution - yellow solution	+ - -
3.	Steroid	- Liberman-bouchard	- red solution - black solution	- +
4.	Terpenoid	- Liberman-bouchard	- red solution - black solution	- +
5.	Saponin	- Aquadest + HCl 2N	- foam	+
6.	Tannin	- FeCl <sub>3</sub>	- black precipitate	+
7.	Glikosida	-CH <sub>3</sub> COOH <sup>(P)</sup> + H <sub>2</sub> SO <sub>4</sub> <sup>(P)</sup>	- green solution	+
8.	Antosianin	-HCl 2N + NH <sub>3</sub>	- purplish blue	+

Description: + : Contains phytochemical constituent

- : Does not contain phytochemical constituent

### Result Characteristics of Simplicia

**Tabel 2:** Result Characteristics of Simplicia of *Clitoria ternatea* L. flower

Characteristics	Result (%)	Standard Value (%)
Water content	9,95 %	< 10
Total ash content	3,82 %	< 8
Water soluble extract content	18,93 %	> 7
Ethanol soluble extract content	10,61 %	> 3,5

### Result Antidiabetic Activity

**Tabel 3:** Antidiabetic effect from Ethanol Extract of *Clitoria ternatea* L. flower in rats

Treatments (dose in mg/kg)	Result of the decrease in glucose levels (mg/dl)						
	Before Induced	After Induced	Day-2	Day-4	Day-6	Day-8	Day-10
- Control	-	-	62,8	-	59,4	-	51,6
+ Control	74,2	253,2	190,4	140,8	104,2	75	48,6
Dose 1	87,6	334	247,6	188,4	131	96,2	48,2
Dose 2	98,2	322,8	218,8	143,6	98,2	61,8	31,2
Dose 3	106	315,8	267	183,6	139,2	96,8	43

#### Description :

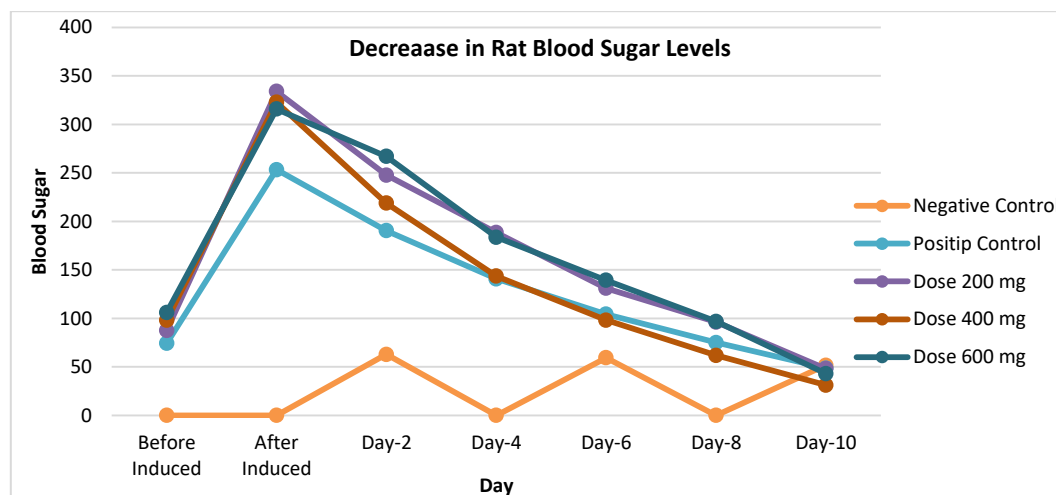
Negative Control = Aquadest

Positive Control = Glibenclamide 5 mg

Dose 1 = *Clitoria ternatea* L. flower ethanol extract 200 mg/kg Body weight

Dose 2 = *Clitoria ternatea* L. flower ethanol extract 400 mg/kg Body weight

Dose 3 = *Clitoria ternatea* L. flower ethanol extract 600 mg/kg Body weight



**Figure 1:** The Decreasing of Blood Sugar Levels

### Statistical data analysis results

**Tabel 4:** Result Statistik Kruskal-Wallis Test

Concentration	Data Normality Test Shapiro-Wilk (sig.)	Kruskal-Wallis Test (sig.)
Dose 1 (200 mg)	0,050	0,001
Dose 2 (400 mg)	0,007	
Dose 3 (600 mg)	0,039	
Negative Control	0,279	
Positive Control	0,197	



## DISCUSSION

### Extraction

The extraction method used in this research is maceration. The maceration method was chosen because it is an easy cold extraction method or a simple method and so that secondary metabolites contained in plants are not damaged, especially compounds that are not heat resistant. When compared to other cold methods, such as percolation, the maceration method is considered more efficient, because the percolation method requires a longer extraction time and more solvent is used. Maceration was carried out for 7 days so that all secondary metabolite compounds that would be drawn were maximally extracted by the solvent. The choice of 96% ethanol is because this solvent is a polar compound, polar compounds are compounds that are soluble in water and have the ability to attract secondary metabolites better.

### Characteristics of Simplicia

From the results of the characteristics of simplicia, it was found that simplicia met all the requirements based on *Materia Medika Indonesia Volume VI*, that the process of making and preparation of good simplicia and simplicia can be used as traditional medicine, This shows that sample preparation, starting from sampling, sorting, drying temperature of the samples used, tools and solvents used in the characteristics meet the requirements, resulting in simplicia that meets the requirements as traditional medicinal preparations that can be used<sup>8,9</sup>.

Flavonoids are known to act as scavengers of hydroxy and superhydroxy radicals thereby protecting the -pancreatic cell membrane lipids against damaging reactions. In addition, flavonoids are also known to reduce lipid peroxidation not only by preventing or slowing the onset of cell necrosis but also by increasing vascularity. With increased vascularity, cell damage can be prevented and cell regeneration can be increased. Likewise with antioxidants as compounds that work to inhibit oxidation by reacting with reactive free radicals to form unreactive free radicals that are not reactive. stable. Antioxidants are all substances that can delay or prevent oxidative damage to the target molecule. In a chemical sense antioxidants are electron donating compounds, but in a broader biological sense again, namely all compounds that can reduce the negative effects of oxidants, including enzymes and metal-binding proteins. Several studies have also revealed the role of oxidative stress caused by free radicals in various dangerous diseases, such as cancer, cardiovascular-related diseases, and degenerative diseases. Researches It also stated that antioxidants have therapeutic value in these diseases. Antioxidants can be obtained in synthetic and natural forms Synthetic antioxidants such as buthylatedhydroxytoluene (BHT), buthylate hydroxyanisole (BHA), and ters-butylhydroquinone (TBHQ) can effectively inhibit oxidation. Synthetic antioxidants are carcinogenic in certain numbers can cause toxins in the body, so natural antioxidants are needed that are safer. Natural antioxidants can be found in vegetables that contain phytochemicals, such as flavonoids, isoflavins, flavones, anthocyanins, and vitamin C<sup>22,23</sup>.

According to Suebkhampt and Sothhibandhu (2011), the blue color of the telang flower indicates the presence of anthocyanins. The crude extract of the telang flower can be used as an alternative dye for staining animal blood cell preparations. Seeing the benefits, the nature of the telang flower which is easy to grow in Indonesia, and safe for consumption, the anthocyanins from the telang flower have the potential to be used as a natural dye in food. The blue color of the telang flower has been used as a blue dye in

sticky rice in Malaysia. Telang flower is also eaten as a vegetable in Kerala (India) and in the Philippines<sup>22,23</sup>.

### Antidiabetic Activity

From Table 3 dan Figure 1 it is known that there was an increase in blood glucose in each treatment group, from the results of measuring blood glucose levels before the induction of alloxan glucose levels in the group under normal conditions, namely the positive control group 74.2 mg/dl, P1 87.6 mg/dl, P2 of 98.2 mg/dl, P3 of 106 mg/dl. From the results of the induction, the average data in the positive control group was 253.2 mg/dl, P1 was 334 mg/dl, P2 was 322.8 mg/dl, P3 was 315.8 mg/dl. Antidiabetic testing using alloxan induction with a dose of 120 mg/kg Body weight.

The mechanism of action of alloxan that causes pancreatic beta cell damage is that it enters the pancreatic beta cells first and then is absorbed by pancreatic beta cells which will determine the level of toxicity and also diabetogenic properties<sup>21</sup>. From the beginning of alloxan induction until the end of the observation, it showed antidiabetic activity except for the negative control treatment, there was no decrease in blood glucose levels because the normal control group was not induced by alloxan only fed 551 and aquadest. So that the content of the 551 feed did not affect the increase in blood sugar levels in rats. In the positive control group there was a decrease from 253.2 mg/dl to 48.6 mg/dl, P1 from 334 mg/dl to 48.2 mg/dl, P2 from 322.8 mg/dl to 31.2 mg/dl, P3 from 315.8 mg/dl to 43 mg/dl. The results of the diagram above show that the best decrease is obtained at P2. With the administration of ethanol extract of telang flower with a dose of 400 mg, the decrease in blood sugar levels in rats was more significant, compared to the administration of the drug glibenclamide 5 mg which had the effect of increasing the performance and number of insulin receptors in muscle fat cells, increasing the efficiency of insulin secretion and potentiating insulin stimulation of carbohydrate transport into the body. muscle cells and fat tissue and decreased glucose production by the liver. This drug works by stimulating the beta cells of the pancreas to release stored insulin. This drug is only useful for type 2 diabetes<sup>10</sup>. In other words, the metabolism of every living thing is different, so that with the administration of high doses of drugs, it cannot be concluded that high doses of drugs work better. Factors that affect the way the drug works can be seen from the formulation of a drug and the blood flow that can increase or slow down how the drug works properly<sup>18</sup>.

Telang or *Clitoria ternatea* L. flower ethanol extract can be a herbal treatment solution for diabetics. This flower extract can reduce blood sugar levels caused by the content of chemical compounds as identified in the phytochemical screening contained in the ethanol extract of *Clitoria ternatea* L. flower. This content has been shown to have pancreatic regeneration activity in diabetic rats. The mechanism of action of secondary metabolites contained in telang flowers such as alkaloids can reduce blood glucose levels by inhibiting glucose absorption in the intestine and increasing glucose transport in the blood, which are active compounds of natural ingredients that have hypoglycemic activity<sup>19</sup>. Flavonoids are phenolic compounds that have active ingredients that act as antioxidants and have bioactivity as antidiabetics<sup>20</sup>. The mechanism of action of anthocyanins is the presence of a natural protection system possessed by anthocyanins, this causes the telang flower extract to be stable in acidic to neutral conditions when given to rats<sup>21</sup>. The mechanism of action of tannins as antidiabetics by inhibiting glucose absorption and acting as a free radical

scavenger<sup>23</sup>. Saponins work by inhibiting blood sugar levels by way of glucose absorption in the small intestine and blood sugar levels will improve<sup>21</sup>. Glycosides work by reducing glucose absorption and intra-pancreatic mechanisms through antioxidant activity that prevents pancreatic beta cell damage. Steroids work by inhibiting the action of the alpha glucosidase enzyme which causes a decrease in blood sugar levels<sup>23</sup>.

The results showed that the ethanol extract of telang flower had a hypoglycemic effect in alloxan-induced diabetic rats. The extract is highly selective in managing complications associated with diabetes mellitus. Therefore, the extract of *Clitoria ternatea* L. flower shows that this plant can be used as a therapy for diabetes complications. For example, oral hypoglycemic drugs of the sulfonylurea group can cause gastrointestinal disturbances in the form of nausea, diarrhea, abdominal pain, and hypersecretion of gastric acid. This has prompted many herbal medicines to be recommended for the treatment of diabetes.

### Statistical Data Analysis

In this study, the data obtained were analyzed statistically. Statistical testing was carried out with the alternative Kruskal-Wallis Test. Kruskal-Wallis Test is a statistical test to determine the significant difference between one group and another. Which aims to determine the difference in the decrease in blood sugar levels in each group. The Kruskal-Wallis test is used to overcome problems that cannot be solved by the One Way ANOVA test. The data is not normally distributed, the data is said to be normal if the significant value is  $> 0.05$ . The basis for decision making in the Kruskal-Wallis Test is that the data is said to be significantly different if the significant value is  $< 0.05$ . Based on the table above, there are 2 groups of data that are not normally distributed. In other words, the One Way ANOVA test requirement is significant  $< 0.05$ , then the data is not met, then the Kruskal-Wallis test is carried out so that it can be concluded that there is a significant difference in decreasing blood sugar levels. This means that each dose has a significant effect on reducing blood sugar levels.

### CONCLUSION

*Clitoria ternatea* L flower ethanol extract can reduce blood sugar levels in male white rats at a dose of 200; 400; 600 mg/kg Body weight. It can be concluded that the ethanol extract of *Clitoria ternatea* L. flower at a dose of 400 mg had a significant decreasing effect on reducing blood glucose levels in alloxan-induced rats.

### CONFLICT OF INTEREST

All authors have nothing to declared

### REFERENCES

- Marpaung AM. Overview of the Benefits of Telang Flower (*Clitoria ternatea* L.) for Human Health. *J Funct Food Nutraceutical*. 2020; 1(2). <https://doi.org/10.33555/jffn.v1i2.30>
- Palimbong S, Sharon PA. The Potential of Telang Flower Extract (*Clitoria ternatea* Linn) as a Colorant in Glutinous Tape Products. *J Science and Health*. 2020; 2.
- Ancient EC. Telang flower (*Clitoria ternatea* L.): utilization and bioactivity. *EduMatScience*. 2020; 4(2):111-24.
- Choiriyah NA. Antioxidant Content in Various Edible Flowers in Indonesia. *J Primary Sciences*. 2020; 4(2):136. <https://doi.org/10.32585/ags.v4i2.892>
- Muliasari H. Education and Early Detection of Diabetes Mellitus as an Effort to Reduce the Prevalence and Risk of Degenerative Diseases. *J Educator and Community Service*. 2019; 2(1):4.
- Agromedia Editor. *The Smart Book of Medicinal Plants 431 Types of Plants Fighting Various Diseases*. Jakarta: PT. Library Agromedicine; 2008.
- Mercubuana. *Blossoms of Telang (Clitoria ternatea) literature review*. 2019.
- Ernawati. *Diabetes Mellitus Nursing Management*. Jakarta: Media Discourse Partners; 2016.
- Primary RY. Effect of Soursop Leaf Extract on Histopathological Picture of Male Rattus Norvegicus Pancreas Induced by Alloxan. *Hang Tuah Med J*. 2020; 17(2):116. <https://doi.org/10.30649/htmj.v17i2.159>
- Husna Y. Antidiabetic activity test of ethanol extract of robusta coffee leaves (*Coffea robusta* L.) on alloxan-induced wistar male white rats. 2019;
- Kuswindayanti NM. Topical Anti-inflammatory Effects of Ethanol Extract of Telang Flower (*Clitoria ternatea* L.) Against Neutrophil Cell Count and Cox-2 Expression in Carrageenin Induced Mice Skin. 2020; 2507:1-9.
- Purwaniati P. Analysis of Total Anthocyanin Levels in Preparations of Telang Flower (*Clitoria ternatea*) with Differential pH Method Using Visible Spectrophotometry. *J Pharmmagazine*. 2020; 7(1):18. <https://doi.org/10.47653/farm.v7i1.157>
- Utami YP. Standardization of Simplicia and Ethanol Extract of Leilem Leaves (*Clerodendrum minhassae* Teijsm. & Binn.). *J Pharm Med Sci*. 2017; 2(1). <https://doi.org/10.35799/pmj.1.2.2018.21655>
- Hendriati L, Kresnamurti A, Widodo T, Ivani E, Anrika M. Hypoglycemic effect and hypersensitivity test for transdermal preparations of Angsana (*Pterocarpus indicus* Wild) extract. *J Farm Science and Applied*. 2015; 2(2):15-9.
- Noviani N, Nurilawati V. *Dental Care Teaching Materials: Pharmacology*. 2017.
- Sumartini, Ikrawan Y. Analysis of Telang Flower (*Clitoria ternatea*) with Variations in pH with the Liquid Chromatograph-Tandem Mass Spectrometry (LC-MS/MS) Method. *Pas Food Technol J*. 2020; 7(2):70-7. <https://doi.org/10.23969/pftj.v7i2.2983>
- Aziza V. Phenotypic Diversity of Double Petal Telang Flowers from Indonesia and Thailand Based on Flower Morphology. *Al-Kaunyah J Biol*. 2021; 14(1):78-89. <https://doi.org/10.15408/kaunyah.v14i1.15558>
- Hartono. Utilization of Telang Flower Extract (*Clitoria ternatea* L.) As Pe Auliasari N, Hindun S, Nugraha H, "Lotion formulation of sweet orange peel ethanol extract (*Citrus X Aurantium* L) as an antioxidant", *Journal of Maritime Pharmacy*, 2018; 9(1):21-34. <https://doi.org/10.52434/jfb.v9i1.640>
- Kusrini E, Tristantini D, Izza N. Activity Test of Telang Flower Extract (*Clitoria ternatea* L.) As an Anti-Cataract Agent. *J Jamu Indonesia*. 2017; 2(1):30-6. <https://doi.org/10.29244/jji.v2i1.28>
- Suebkhampet, A., dan Sotthibandhu, P. Effect of Using Aqueous Crude Extract From Butterfly Pea Flowers (*Clitoria ternatea* L.) As a Dye on Animal Blood Smear Staining. 2011. *Suranaree Journal of Science Technology*. 19(1):15-19.
- Lee, M. P., Abdullah, R., dan Hung, K. L. 2011. Thermal Degradation of Blue Anthocyanin Extract of *Clitoria ternatea* Flower. *International Conference on Biotechnology and Food Science IPCBEE*. 7:49-53.
- Ginting EE, Fathin L, Ginting P, Sari DP, Parhan, Leny. Preparation of Moisturizing Lotion from Combination Extract of *Clitoria ternatea* Flower and Dragon Fruit Peels, *Journal of Drug Delivery and Therapeutics*. 2022; 12(3-S):81-86. <https://doi.org/10.22270/jddt.v12i3-S.5509>